WHAT IS CLAIMED IS:

1. A method for treating a surface of a substrate, the method comprising:

(a) forming active sites on a carbon-containing substrate surface by exposing the substrate surface to a plasma;

(b) reacting a first gas comprising spacer molecules with the active sites *in situ* in the absence of plasma to provide surface-bound spacer chains; and

(c) reacting a second gas comprising spacer chain extender molecules with the surface-bound spacer chains *in situ* in the absence of plasma to provide extended spacer chains, wherein the extended spacer chain comprises at least one reactive functional group that is not a chloracid group.

2. The method of claim 1, further comprising immobilizing biomolecules on the substrate surface by reacting the biomolecules with the at least one reactive functional group of the extended spacer chains.

3. The method of claim 1, wherein the substrate is a polymeric substrate.

4. The method of claim 3, wherein the substrate comprises a polymer selected from the group consisting of polyethylene, polystyrene, polycarbonate, polymethyl methacrylate and polypropylene.

5. The method of claim 1, wherein the substrate comprises polytetrafluoroethylene.

6. The method of claim 1, wherein the substrate comprises a diamond-like carbon film.

7. The method of claim 1, wherein the substrate comprises a carbon nanoparticle.

8. The method of claim 7, wherein the substrate comprises a carbon nanotube.

9. The method of claim 1, wherein the substrate comprises a material selected from the group consisting of diamond and graphite.

10. The method of claim 1, wherein the first gas comprises diamine molecules.

11. The method of claim 10, wherein the diamine molecules are ethylenediamine molecules.

12. The method of claim 1, wherein the first gas comprises diepoxide molecules.

13. The method of claim 12, wherein the diepoxide molecules comprise 1,4-butanediol diglycidyl ether molecules.

14. The method of claim 1, wherein the second gas has a vapor pressure of at least about 200 mTorr at 20°C.

15. The method of claim 1, wherein the second gas comprises dialdehyde molecules.

16. The method of claim 15, wherein the dialdehyde molecules are glutaric dialdehyde molecules.

17. The method of claim 1, wherein the second gas comprises anhydride molecules.

18. The method of claim 17, wherein the anhydride molecules are hexafluoroglutaric anhydrides molecules.

19. The method of claim 1, wherein the second gas comprises dichloride molecules.

20. The method of claim 19, wherein the dichloride molecules are dimethyldichlorosilane molecules.

21. The method of claim 10, wherein the second gas comprises diepoxide molecules.

22. The method of claim 21, wherein the diepoxide molecules are 1,4-butanediol diglycidyl ether molecules.

23. The method of claim 1, wherein the plasma is an argon plasma.

24. The method of claim 1, wherein the plasma is an argon and hydrogen plasma.

25. The method of claim 1, wherein the plasma is a hydrogen plasma.

26. The method of claim 2, wherein the biomolecule is selected from the group consisting of oligonucleotides, aptamers, cDNA and RNA.

27. The method of claim 2, wherein the biomolecule is an protein.

28. The method of claim 2, further comprising exposing the immobilized biomolecules to a reducing agent.

29. A method for treating a surface of a substrate, the method comprising:

(a) forming active sites on a carbon-containing substrate surface by exposing the carbon-containing substrate surface to a plasma; and

(b) reacting a first gas comprising spacer molecules having at least two different reactive functional groups with the active sites *in situ* in the absence of plasma to provide surface-bound spacer chains.

30. The method of claim 29, wherein the spacer molecules comprise epihalohydrin molecules.

31. The method of claim 29, further comprising immobilizing biomolecules on the substrate surface by reacting the biomolecules with the surface-bound spacer chains.

32. A method for treating a surface of a substrate, the method comprising:

(a) forming active sites on a carbon-containing substrate surface by exposing the carbon-containing substrate surface to a plasma;

(b) reacting a first gas comprising spacer molecules with the active sites *in situ* in the absence of plasma to provide surface-bound spacer chains;

(c) reacting a second gas comprising spacer chain extender molecules with the spacer chains *in situ* in the absence of plasma to provide extended spacer chains; and

(d) reacting a third gas comprising spacer chain extender molecules with

the extended spacer chains *in situ* in the absence of plasma to further extend the spacer chains.

33. The method of claim 32, further comprising immobilizing biomolecules on the substrate surface by reacting the biomolecules with the further extended spacer chains.

34. A method for treating the surfaces of carbon-containing nanotubes or nanoparticles, the method comprising:

(a) forming active sites on the surfaces of carbon-containing nanotubes or nanoparticles by exposing the nanotubes or nanoparticles to a plasma; and

(b) reacting a first gas comprising spacer molecules with the active sites *in situ* in the absence of plasma to provide surface-bound spacer chains.

35. The method of claim 34, further comprising reacting a second gas comprising spacer chain extender molecules with the surface-bound spacer chains to provide extended spacer chains.

36. The method of claim 35, further comprising immobilizing biomolecules on the nanotubes or nanoparticles by reacting the biomolecules with the extended spacer chains.

37. A method for treating a diamond-like carbon surface, the method comprising:

(a) forming active sites on the diamond-like carbon surface by exposing the surface to a plasma; and

(b) reacting a first gas comprising spacer molecules with the active sites *in situ* in the absence of plasma to provide surface-bound spacer chains.

38. A carbon-containing surface comprising:

(a) a carbon-containing surface;

(b) spacer chains covalently bound to the carbon-containing surface, the spacer chains formed by reacting molecules selected from the group consisting of epichlorohydrin, epibromohydrin, epifluorohydrin, 1,4-butanediol diglycidyl ether and combinations thereof with the surface; and

(c) biomolecules covalently bound to the spacer chains.

39. A surface treated carbon-containing nanotube or nanoparticle comprising:

(a) a carbon-containing nanotube or nanoparticle;

(b) spacer chains covalently bound to the nanotube or nanoparticle; and

(c) biomolecules covalently bound to the spacer chains;

wherein the spacer chains are formed from molecules selected from the group consisting of dialdehyde molecules, anhydride molecules, dichloride molecules, epihalohydrin molecules, diepoxide molecules and combinations thereof.

40. A surface treated diamond-like carbon film comprising:

(a) a diamond-like carbon film;

(b) spacer chains covalently bound to the diamond-like carbon film; and

(c) biomolecules covalently bound to the spacer chains;

wherein the spacer chains are formed from molecules selected from the group consisting of dialdehyde molecules, anhydride molecules, dichloride molecules, epihalohydrin molecules, diepoxide molecules and combinations thereof.

41. The diamond-like carbon film of claim 40, wherein the diamond-like carbon film is disposed on a substrate.

42. A carbon-containing substrate comprising:

(a) a carbon-containing substrate surface;

(b) one or more molecular spacer chains covalently bound to the surface, the one or more spacer chains having a length of at least 2.5 nm; and

(c) one or more biomolecules covalently bound to the one or more molecular spacer chains.

43. The substrate of claim 42, wherein the substrate surface comprises a polymeric surface.

44. The substrate of claim 42, wherein the substrate surface comprises a diamond-like carbon film.

45. The substrate of claim 42, wherein the substrate surface comprises a carbon nanotube or carbon nanoparticle surface.

46. The substrate of claim 42, wherein the one or more spacer chains have a length of at least 4 nm.

47. The substrate of claim 42, wherein the one or more spacer chains have a length of at least 5 nm.

48. The substrate of claim 42, wherein the one or more biomolecules are proteins.

49. The substrate of claim 42, wherein the one or more biomolecules are enzymes.

50. The substrate of claim 42, wherein the one or more biomolecules are oligonucleotides.